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AN EVALUATION OF VARIOUS PERMANENT RESTORATIVE MATERIALS: EFFEC--ETC(U)

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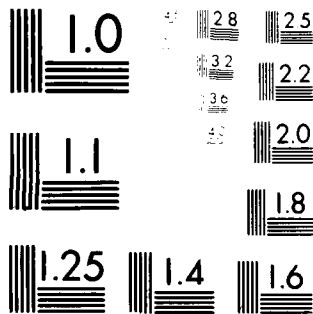
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An Evaluation of Various Permanent Restorative Materials'
Effect on the Shade of Bleached Teeth

William F. Freccia, BS, DDS, MS
Donald D. Peters, BA, DDS, MS
Lewis Lorton, BA, DDS, MSD

Commercial materials and equipment are identified in this report to specify the investigation procedures. Such identification does not imply recommendation or endorsement, or that the materials and equipment are necessarily the best available for the purpose.

The opinions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of the Defense.

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ABSTRACT

Thirty-six teeth were stained, bleached and restored using four restorative techniques. The final tooth shade was determined subjectively by visual observance, and objectively by actual measurement of light transference. The teeth with silicate in the canal and chamber, when compared to those with white cement or composite in the canal and chamber, were subjectively evaluated as lighter at a significance level of $p < .02$. Evaluation, utilizing light transference, showed that when only silicate was placed in the canal, chamber and access preparation, there was greater translucency at a significance level of $p < .0002$. Evaluation of both objective and subjective data indicated that the preferable technique for restoring bleached teeth would be silicate in the canal and chamber area covered by a composite in the access preparation.

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Bleaching of pulpless teeth has been reported at least since 1877.¹ The tendency of some of the bleached teeth to rediscolor has been a common finding.²⁻⁶ To try and minimize this problem, and optimize translucency, several solutions such as an acrylic nononer, chloral hydrate and silicone fluid have been forced into the dentinal tubules following bleaching.² It has also been recommended that a slight overbleach is desired.³⁻⁵ Most authors don't delve into how the lingual restoration relates to the final esthetic results; they just recommend a lingual fill of silicate, resin, or composite.^{2-4, 7-9} Other authors have recommended filling the chamber with a white cement covered by a resin or composite.^{1,2,5,6} Brown¹⁰ has discussed the possibility that the chamber should be filled with a more translucent material and did suggest use of a light silicate covered by a permanent restoration. Frank⁵ states that this recommendation appears to be based on empiricism and may be of questionable value.

The purpose of this study was to evaluate just what effect various restorations do have on the final shade of bleached pulpless anterior teeth.

METHODS & MATERIALS

Thirty-six extracted anterior teeth were stained artificially, bleached and sealed with cotton and cavit as described previously.^{11,12} Using standard shade guides, shades for the teeth were determined subjectively by visual observation by the three authors just prior to final restoration. This was done with and without the temporary

restoration being present. At this time, light transmission of the teeth was also checked objectively by mechanical means with and without the temporaries in place. A schematic of the procedure for measuring translucency of the optical density by mechanical means is shown in Fig. 1. The procedure, developed by Vire,¹³ consists of attaching small diameter fiber optic bundles (2.79mm in diameter) securely against the cervical area of the facial and lingual coronal surfaces of teeth using rubber dam clamps, modified using acrylic guides, and silicone rubber. The fiber bundle passes through the acrylic guides and rests against the tooth surface. Silicone rubber then made a tight seal around the acrylic guides and fiber bundles.

A remote light with a controlled constant intensity was beamed via the fiber bundle to the buccal surface. The light passed through the tooth and was picked up by the lingual fiber bundles. A solid state photoresistor-photocell (VT 217 Photocell, Vatec Inc., Maryland Heights, MO 63043) was used to convert the light entering the lingual fiber to an electrical signal. The resultant impulse was coupled directly to a differential amplifier (ADS 20V Instrumentation Amplifier, Analog Device Inc., Norwood, MD). Extraneous noises were stripped from the signal by an electronic filter (Rockland Model 432 Dual Hi/Lo Filter, Rockland System Corp., W. Nyack, NY 10994). The filtered impulses were displayed instantly on a voltmeter and recorded. To ensure that any alteration in light in the surrounding area would not affect the system, a black cloth covered the tooth and fiber optic components during the test procedure.

The 30 teeth were divided into four groups and the pulp chambers and lingual access preparation filled as follows:

- GROUP 1. Silicate (MQ 51, S.S. White, Philadelphia, PA) in the pulp chamber and lingual access preparation.
- GROUP 2. Silicate in the pulp chamber and composite (Concise, 3M Company, St. Paul, Minnesota) in the access preparation (Fig 2).
- GROUP 3. White cement (Flecks Cement, Snow White, Mizzy, Inc., Clifton Forge, VA) in the pulp chamber and composite in the access preparation.
- GROUP 4. Composite in the pulp chamber and lingual access preparation.

After restoration, the shades of the teeth were again determined subjectively (visually), and objectively (mechanically).

RESULTS

The differences when evaluated subjectively by three investigators were minimal. Differences between teeth with chambers left empty compared to the same teeth restored with cotton and cavit were non-significant. Also, the differences between the four groups prior to final restoration were nonsignificant. Table 1 shows, when using Chi-square with Yates' correction, there was no significant difference. However, if the data is combined into cases with silicate in the chamber versus cases with white cement or composite in the chamber, the data using Fisher's exact probability tests is significant at a $p < .0202$ level (Table 2).

There did appear to be greater variation shown by the objective voltage transference readings. The average differences shown by voltage transference before and after final restoration is shown in Table 3. An analysis of variance did show a significant difference between groups after restoration ($F=8.9321$ $p<.0002$). An analysis of variance of difference of light transference between groups before fill again showed no significant difference ($F=.7630$ $p<.5232$). An analysis of variance on the difference in light transference allowed by teeth with open lingual access and chamber, to those filled with cotton and cavit, also gave no significant difference ($F=.7701$ $p<.5193$).

DISCUSSION

First, some discussion is needed on the method of handling the subjective evaluation. The basis of agreement in shade selection was surprisingly high. After restoration, in no case did any evaluator rank a tooth as lighter while another ranked it as darker. In three cases, two investigators ranked a tooth as lighter or darker while one investigator ranked it as the same shade (no change). In two cases, two investigators ranked the tooth as the same shade while one ranked it as lighter or darker. In each of these cases, the tooth was placed in the category agreed on by the two evaluators.

The main discrepancy in the study appears to be that subjective evaluation noted little difference between Groups 1 and 2, while objective evaluation by voltage readings did give a significant difference in light transference. Both evaluation techniques did show

that composite interfered with light transference. When this fact is added to what is shown by Figure 2, this apparent discrepancy may be explained. When the evaluators visually checked the teeth, the main area determining the shade was the body of the tooth, where silicate in the chamber should allow light transference. However, when the fiber optic bundles are placed next to the tooth, composite in the lingual access opening may have partially inhibited the light transference. The results appear to confirm this idea since, visually, Groups 1 and 2 related well (Table 1). Therefore for optimal results, it would appear that silicate in the chamber by itself would be best, but clinically silicate does wash out and is not an ideal restoration. At the same time, while composite does appear to inhibit light transference when it is used only in the lingual access opening, the clinical effect by subjective analysis was minimal.

The possibility that the composite may have interfered with light transference in Group 2 does elicit a question. Why didn't the cotton and cavit interfere with light transference? Again, a proposed answer is that very little cotton or cavit was used to seal the teeth temporarily. This was done since the temporary had no actual function and did have to be removed prior to the final restoration. However, the cavit and composite thicknesses were not measured.

Composite alone in the chamber and access preparation appears to be a poor idea for two reasons. First, these findings seem to confirm that it does appear to interfere with tooth translucency. Second, if the tooth does discolor or fracture in the future, it is difficult to

tell what is composite and what is tooth structure when you attempt to rebleach or place a post and core. Silicate, clinically, appears much easier to remove than composite since it has a chalky appearance when it dries out or when a bur is used on it. Therefore, it appears that the ideal procedure would be to fill the chamber with silicate, and then cover it with a composite restoration in the lingual access preparation, as suggested by Brown.¹⁰

SUMMARY AND CONCLUSION

Thirty-six teeth were stained, bleached, and restored using four restorative techniques. The final tooth shades were evaluated subjectively by visual observation, and objectively by measurement of light transference. It was concluded that silicate allowed the greatest light transference when evaluated by either technique. Also, while composite definitely inhibited light transference, its use to fill the lingual restoration over silicate in the canal and chamber was clinically insignificant. Therefore, filling any unfilled canal and chamber with silicate and covering it with composite appears to be the treatment of choice for bleached teeth.

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Dr. Freccia, formerly an endodontic resident, US Army Institute of Dental Research, is now chief, endodontics, US Army DENTAC, Ft. Bragg, NC. Dr. Peters is director, endodontic residency program, US Army Institute of Dental Research, Washington, DC; Dr. Lorton is a research dental officer and assistant research coordinator, US Army Institute of Dental Research.

Requests for reprints should be directed to:

Col. Donald D. Peters
Director, Endodontic Residency Program
US Army Institute of Dental Research
Walter Reed Army Medical Center
Washington, DC 20012

Table 1. Subjective determination of shade following final restorations.

Groups	Darker	No Change	Lighter
Silicate	3	4	2
Silicate + Composite	4	3	2
Composite + White Cement	7	1	1
Composite	7	1	1

df=6 $\chi^2=6.0924$ $p<.25$

Table 2. Subjective comparison of shades with data combined into all cases with silicate in the chamber versus all cases with other restorative material in the chamber.

Group	Darker	No Change or Lighter
Silicate	7	11
White Cement or Composite	14	4

$p < .0202$

Table 3. Average loss of translucency shown by voltage output readings.

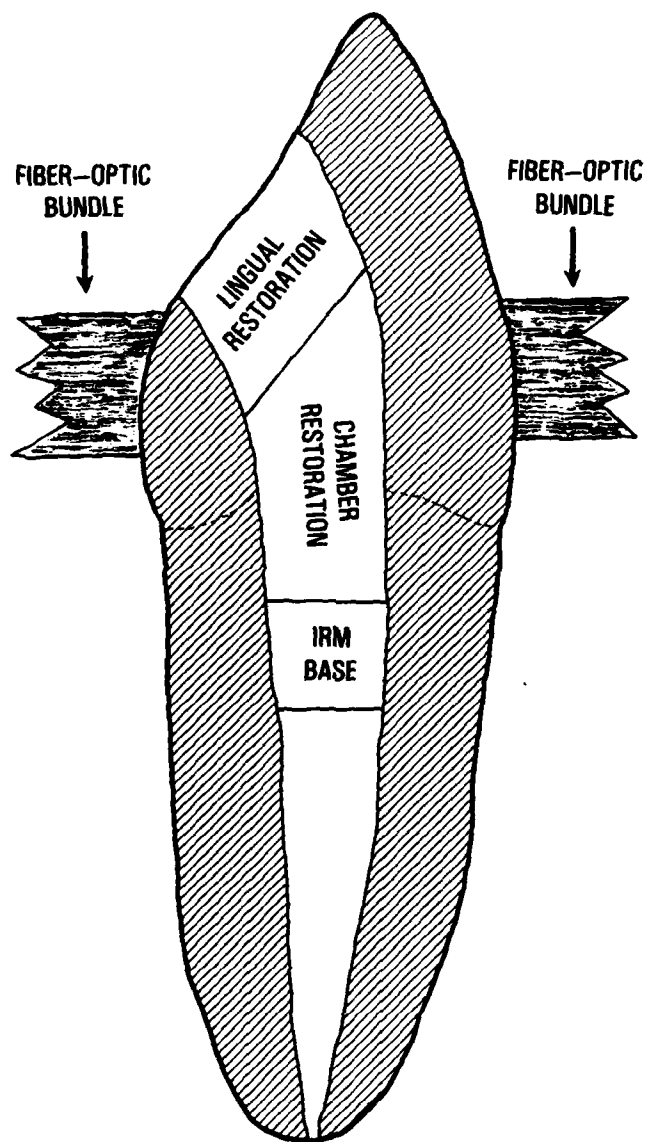
Groups	No Restoration*	Restoration	Difference**
Silicate	10.33	10.55	.22
Silicate + Composite	13.67	25.89	12.22
White Cement + Composite	10.33	30.33	20.00
Composite	16.89	30.22	13.33

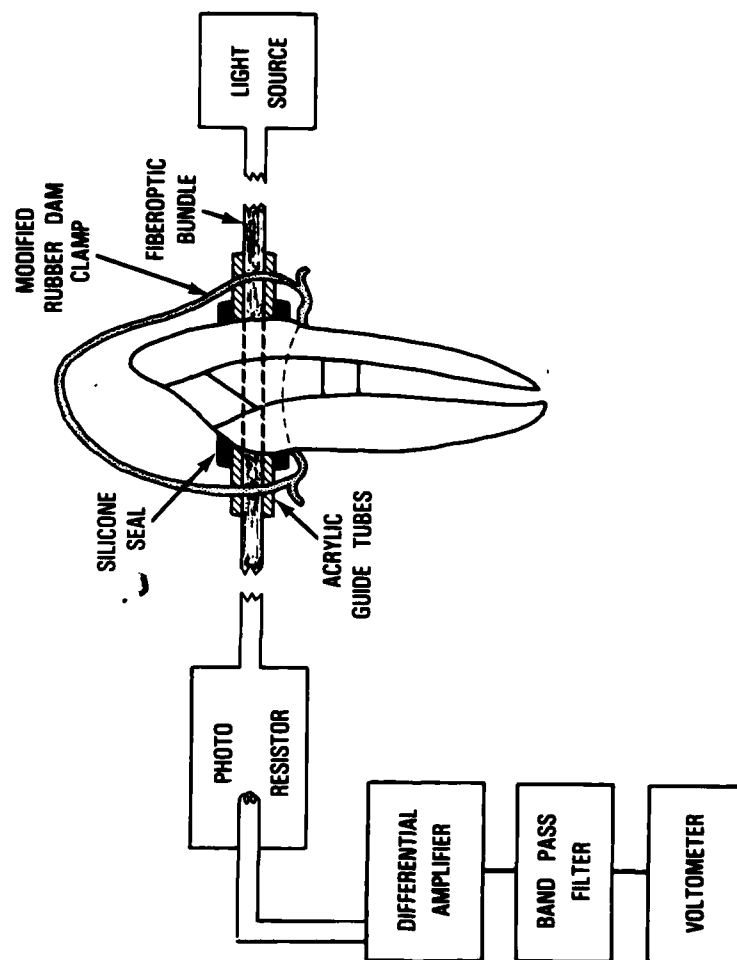
*F=.7630 p <.5232

**F=8.9321 p <.0002

Figure 1. Schematic of technique utilized to objectively determine translucency of restorations.

Figure 2. Schematic illustrating relationship of restorations and fiber-optic bundles.





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